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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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NATIONAL EUTROPHICATION SURVEY

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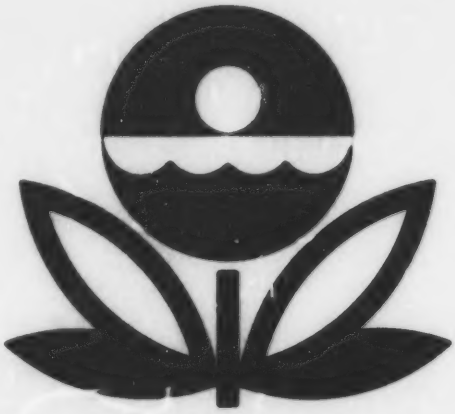

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REPORT
ON
BRANCHED OAK RESERVOIR
LANCASTER COUNTY
NEBRASKA
EPA REGION VII
WORKING PAPER No. 554

WITH THE COOPERATION OF THE
NEBRASKA DEPARTMENT OF ENVIRONMENTAL CONTROL
AND THE
NEBRASKA NATIONAL GUARD
AUGUST, 1976

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F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Nebraska Department of Environmental Control for professional involvement, to the Nebraska National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

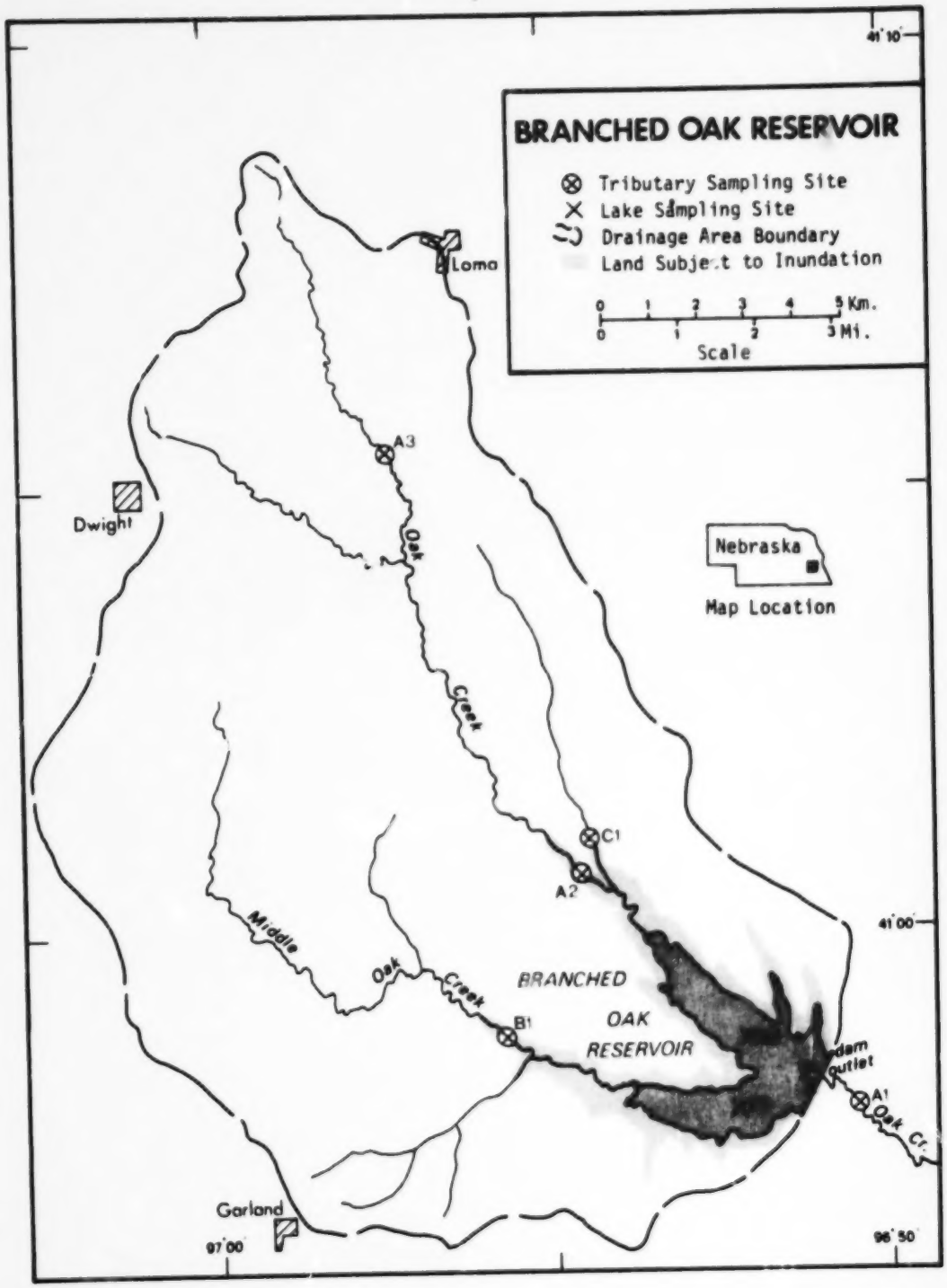
The staff of the Water Pollution Control Division, Department of Environmental Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Francis L. Winner, the Adjutant General of Nebraska, and Project Officer Colonel Burl M. Johnson, who directed the volunteer efforts of the Nebraska National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STATE OF NEBRASKA

RESERVOIR NAME	COUNTY
Branched Oak	Lancaster
Harlan County	Harlan
Harry D. Strunk	Frontier
Hugh Butler	Frontier, Red Willow
Johnson	Dawson, Gosper
McConaughy	Keith
Pawnee	Lancaster
Sherman	Sherman
Swanson	Hitchcock


BRANCHED OAK RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Land Subject to Inundation
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale
41°10'
Loma
A3
Dwight
Oak
Creek
Nebraska
Map Location
C1
A2
41°00'
Middle
Oak
Creek
BRANCHED
OAK
RESERVOIR
B1
dam
outlet
A1
Oak Cr.
Garland
97°00'
96°50'

BRANCHED OAK RESERVOIR

STORET NO. 3101

1

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Branched Oak Reservoir is eutrophic. It ranked second in overall trophic quality when the nine Nebraska reservoirs sampled in 1974 were compared using a combination of six parameters*. One of the other reservoirs had less median total phosphorus, three had less median dissolved phosphorus, none of the others had less median inorganic nitrogen, six had less mean chlorophyll a, and three had greater mean Secchi disc transparency. Survey limnologists noted a phytoplankton bloom in progress at station 1 in April.

Branched Oak Reservoir receives runoff water high in dissolved nutrients principally from cultivated farmland, and the reservoir has had symptoms of eutrophy since the second year of impoundment (Hammer and Hergenrader, 1974).

B. Rate-Limiting Nutrient:

Because of nutrient losses in the samples, the algal assay results are not considered indicative of conditions in the reservoir at the times of sampling (04/17/74 and 09/26/74). The reservoir data indicate nitrogen limitation at both sampling times.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Branched

* See Appendix A.

Oak Reservoir during the sampling year. Nonetheless, the present phosphorus loading of 0.72 $g/m^2/yr$ is more than twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). Any reduction of nutrient inputs to the reservoir will require control of non-point source contributions (see below).

2. Non-point sources--The phosphorus loads of the two gaged tributaries amounted to 63.5% of the total load reaching the reservoir. The estimated phosphorus load of the ungaged streams amounted to 34.1% of the total load.

Because of the lack of point sources and the agricultural practices in the watershed (Sheets, 1975), reduction of nutrient inputs is dependent on improved land-use practices in the drainage area.

The phosphorus export rates of Oak and Middle Oak creeks (see page 10) compare well with those of unimpacted Middle Creek and Unnamed Stream B-1, tributaries of nearby Pawnee Reservoir* (26 $kg/km^2/yr$).

* Working Paper No. 560.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 7.28 kilometers^2.
2. Mean depth: 5.5 meters.
3. Maximum depth: 11.0 meters.
4. Volume: 40.040 x 10^6 m^3.
5. Mean hydraulic retention time: 2.8 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Oak Creek	73.8	0.26
Middle Oak Creek	60.6	0.22
Minor tributaries & immediate drainage -	73.0	0.28
Totals	207.4	0.76

2. Outlet -

Oak Creek	214.7**	0.46

C. Precipitation***:

1. Year of sampling: 60.4 centimeters.
2. Mean annual: 67.7 centimeters.

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† Table of metric conversions--Appendix B.
†† Adamovich, 1975; Hartung, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Branched Oak Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the reservoir and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and third visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 10.7 meters at station 1, 7.6 meters at station 2, and 6.1 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR BRANCHED OAK
STORET CODE 3101

PARAMETER	1ST SAMPLING (4/17/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 2/74) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/26/74) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.1 - 9.7	9.4	9.4	22.7 - 23.5	23.2	23.4	17.1 - 18.1	17.5	17.3
DISS OXY (MG/L)	10.2 - 10.6	10.5	10.6	5.6 - 6.2	5.9	6.0	7.4 - 9.2	8.5	8.5
CNDCTVY (MCROMO)	343. - 348.	346.	345.	468. - 475.	472.	471.	403. - 412.	407.	406.
PH (STAND UNITS)	****** -**********			7.8 - 8.0	7.8	7.8	7.7 - 7.8	7.8	7.8
TOT ALK (MG/L)	218. - 226.	222.	222.	****** -**********			262. - 290.	271.	274.
TOT P (MG/L)	0.025 - 0.044	0.031	0.030	****** -**********			0.059 - 0.096	0.076	0.078
ORTHO P (MG/L)	0.004 - 0.013	0.009	0.009	****** -**********			0.023 - 0.030	0.026	0.025
NO2+NO3 (MG/L)	0.020 - 0.060	0.045	0.050	****** -**********			0.020 - 0.620	0.081	0.020
AMMONIA (MG/L)	0.020 - 0.050	0.038	0.040	****** -**********			0.040 - 0.050	0.044	0.040
KJEL N (MG/L)	0.600 - 0.980	0.782	0.800	****** -**********			0.700 - 1.200	0.918	0.900
INORG N (MG/L)	0.040 - 0.110	0.083	0.090	****** -**********			0.060 - 0.670	0.125	0.060
TOTAL N (MG/L)	0.660 - 0.950	0.826	0.840	****** -**********			0.720 - 1.520	0.991	0.970
CHLRPYL A (UG/L)	10.4 - 12.9	11.4	11.0	6.4 - 27.5	14.6	9.8	21.1 - 32.1	25.1	22.1
SECCHI (METERS)	1.4 - 1.4	1.4	1.4	0.9 - 0.9	0.9	0.9	0.9 - 1.1	1.0	1.1

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/17/74	1. *Asterionella sp.*	15,728
	2. Flagellates	2,192
	3. *Dinobryon sp.*	1,334
	4. *Cryptomonas sp.*	572
	5. *Ankistrodesmus sp.*	191
	Other genera	381
	Total	20,398
07/02/74	1. *Carteria sp.*	1,541
	2. Flagellates	572
	3. *Cryptomonas sp.*	396
	4. Cysts	308
	5. *Aphanizomenon sp.*	220
	Other genera	926
	Total	3,963
09/26/74	1. *Melosira sp.*	5,603
	2. *Cryptomonas sp.*	580
	3. *Aphanizomenon sp.*	515
	4. Flagellates	322
	5. *Coelosphaerium sp.*	258
	Other genera	773
	Total	8,051

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/17/74	1	10.4
	2	11.0
	3	12.9
07/02/74	1	27.5
	2	9.8
	3	6.4
09/26/74	1	22.1
	2	32.1
	3	21.1

C. Limiting Nutrient Study:

There was a significant change in nutrients in the algal assay samples from the time of collection to the beginning of the assays. Therefore, the results are not considered representative of conditions in the reservoir at the times of sampling.

The reservoir data indicate nitrogen limitation; i.e., the mean inorganic nitrogen to orthophosphorus ratios were less than 10 to 1 both sampling times, and nitrogen limitation would be expected.

iv. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Nebraska National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of May and June when two samples were collected. Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nebraska District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations A-2 and B-1 and multiplying the means by the ZZ area in km^2.

No known point sources impacted Branched Oak Reservoir during the Survey sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Oak Creek	1,955	37.2
Middle Oak Creek	1,380	26.3
b. Minor tributaries & immediate drainage (non-point load) -	1,790	34.1
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	125	2.4
Total	5,250	100.0

2. Outputs -

Lake outlet - Oak Creek 1,035

3. Net annual P accumulation - 4,215 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Oak Creek	15,670	28.1
Middle Oak Creek	15,290	27.4
b. Minor tributaries & immediate drainage (non-point load) -	16,935	30.4
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	7,860	14.1
Total	55,755	100.0

2. Outputs -

Lake outlet - Oak Creek 16,065

3. Net annual N accumulation - 39,690 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Oak Creek	26	212
Middle Oak Creek	23	252

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Oak Creek (station A-3)	0.206	2.069
Unnamed Stream C-1	0.248	2.779

* See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.72	0.58	7.7	5.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Branched Oak Reservoir:

"Dangerous" (eutrophic loading)	0.28
"Permissible" (oligotrophic loading)	0.14

V. LITERATURE REVIEWED

Adamovich, Ted, 1975. Personal communication (reservoir morphometry). NE Dept. of Environ. Contr., Lincoln.

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3101	BRANCHED OAK	0.044	0.070	456.444	17.033	9.400	0.013
3102	HARLAN COUNTY RESERVOIR	0.112	0.365	476.111	27.822	12.200	0.061
3103	HARRY D. STRUNK (MEDICIN	0.064	0.460	470.500	14.367	14.200	0.004
3104	HUGH BUTLER (RED WILLOW)	0.061	0.090	468.875	16.612	14.400	0.014
3105	JOHNSON RESERVOIR	0.075	0.340	477.667	26.133	8.600	0.004
3106	LAKE MCCONAUGHY	0.027	0.585	409.555	8.644	11.400	0.004
3107	PAWNEE LAKE	0.060	0.175	453.000	15.367	8.800	0.020
3108	SHERMAN COUNTY RESERVOIR	0.067	0.090	451.167	6.717	11.800	0.050
3110	SWANSON RESERVOIR	0.067	0.090	466.333	14.450	11.000	0.016

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3101	BRANCHED OAK	88 (7)	100 (8)	63 (5)	25 (2)	75 (6)	63 (5)	414
3102	HARLAN COUNTY RESERVOIR	0 (0)	25 (2)	13 (1)	0 (0)	25 (2)	0 (0)	63
3103	HARRY D. STRUNK (MEDICIN	50 (4)	13 (1)	25 (2)	75 (6)	13 (1)	81 (6)	257
3104	HUGH BUTLER (RED WILLOW)	63 (5)	75 (5)	38 (3)	38 (3)	0 (0)	50 (4)	264
3105	JOHNSON RESERVOIR	13 (1)	38 (3)	0 (0)	13 (1)	100 (8)	81 (6)	245
3106	LAKE MCCONAUGHY	100 (8)	0 (0)	100 (8)	88 (7)	50 (4)	100 (8)	438
3107	PAWNEE LAKE	75 (6)	50 (4)	75 (6)	50 (4)	88 (7)	25 (2)	363
3108	SHERMAN COUNTY RESERVOIR	38 (3)	75 (5)	88 (7)	100 (8)	38 (3)	13 (1)	352
3110	SWANSON RESERVOIR	25 (2)	75 (5)	50 (4)	63 (5)	63 (5)	38 (3)	314

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3106	LAKE MCCONAUGHY	438
2	3101	BRANCHED OAK	414
3	3107	PAWNEE LAKE	363
4	3104	SHERMAN COUNTY RESERVOIR	352
5	3110	SWANSON RESERVOIR	314
6	3.0%	HUGH BUTLER (RED WILLOW)	264
7	3103	HARRY D. STRUNK (MEDICIN	257
8	3105	JOHNSON RESERVOIR	245
9	3102	HARLAN COUNTY RESERVOIR	63

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

T..BUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3101 BRANCHED OAK LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 214.7

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3101A1	214.7	0.37	0.62	0.76	0.82	0.71	0.51	0.22	0.08	0.08	0.74	0.34	0.31	0.40
3101A2	73.8	0.24	0.31	0.45	0.48	0.48	0.26	0.13	0.07	0.13	0.34	0.20	0.16	0.26
3101B1	60.6	0.19	0.25	0.37	0.34	0.48	0.22	0.10	0.06	0.10	0.27	0.16	0.13	0.22
3101ZZ	80.3	0.25	0.34	0.48	0.42	0.54	0.26	0.13	0.08	0.14	0.34	0.21	0.17	0.28

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 214.7
SUM OF SUB-DRAINAGE AREAS = 214.7

TOTAL FLOW IN = 9.15
TOTAL FLOW OUT = 5.56

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3101A1	8	74	0.03	24	0.0				
	9	74	0.0	21	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	15	0.0				
	12	74	0.0	7	0.0				
	1	75	0.0	12	0.0				
	2	75	0.06	2	0.0				
	3	75	0.68	11	0.42				
	4	75	1.22	12	1.22				
	5	75	0.82	4	1.22				
	6	75	0.74	7	0.34				
	7	75	0.25	12	0.14				
	8	75	0.08						
3101A2	8	74	0.15	25	0.05				
	9	74	0.05	22	0.05				
	10	74	0.13	20	0.03				
	11	74	0.06	16	0.06				
	12	74	0.08	14	0.05				
	1	75	0.11	19	0.0				
	2	75	0.14	22	0.0				
	3	75	0.37	16	0.11				
	4	75	0.48	13	0.13				
	5	75	0.27	2	0.06	17	0.05		
	6	75	0.42	8	0.07	22	0.06		
	7	75	0.06						

TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3101 BRANCHED OAK LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3101M1	8	74	0.12	25	0.04				
	9	74	0.04	22	0.08				
	10	74	0.10	20	0.05				
	11	74	0.05	16	0.06				
	12	74	0.07	14	0.05				
	1	75	0.09	19	0.0				
	2	75	0.11	22	0.0				
	3	75	0.31	16	0.07				
	4	75	0.40	13	0.08				
	5	75	0.22	2	0.07	17	0.05		
	6	75	0.34	8	0.05	22	0.07		
	7	75	0.05						
3101Z2	8	74	0.16	25	0.06				
	9	74	0.05	22	0.08				
	10	74	0.14	20	0.05				
	11	74	0.06	16	0.07				
	12	74	0.08	14	0.06				
	1	75	0.12	19	0.0				
	2	75	0.15	22	0.0				
	3	75	0.40	16	0.11				
	4	75	0.54	13	0.12				
	5	75	0.28	2	0.08	17	0.06		
	6	75	0.45	8	0.07	22	0.08		
	7	75	0.06						

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APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

310101
40 58 14.0 096 51 16.0
BRANCHED OAK
31109 NEBRASKA

11EPALES
3

2111202
0040 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	10 35	0000	9.7		54	348		220	0.040	0.600	0.060	0.004
	10 35	0005	9.7	10.6		348		220	0.050	0.700	0.060	0.009
	10 35	0015	9.7	10.6		348		222	0.030	0.800	0.020	0.013
	10 35	0035	9.5	10.6		347		218	0.040	0.800	0.060	0.009
74/07/02	10 25	0000	23.5	5.6	36	474	7.90					
	10 25	0005	23.4	6.0		474	8.00					
	10 25	0015	23.4	6.0		474	7.90					
	10 25	0028	23.3	5.6		475	7.80					
74/09/26	13 45	0000	18.1	9.0	36	412	7.85	278	0.040	1.100	0.020	0.028
	13 45	0005	18.1	8.2		412	7.84	284	0.050	1.000	0.020	0.030
	13 45	0015	17.8	9.0		410	7.80	276	0.050	0.900	0.620	0.025
	13 45	0027	17.2	7.4		406	7.66	266	0.050	0.800	0.020	0.023

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/17	10 35	0000	0.025	10.4	
	10 35	0005	0.044		
	10 35	0015	0.034		
	10 35	0035	0.030		
74/07/02	10 25	0000		27.5	
	10 25	0008			1.0
74/09/26	13 45	0000	0.087	22.1	
	13 45	0005	0.076		
	13 45	0007			1.0
	13 45	0015	0.077		
	13 45	0027	0.059		

STORET RETRIEVAL DATE 75/12/23

310102
40 58 45.0 096 52 12.0
BRANCHED OAK
31109 NEBRASKA

11EPALES
3

2111202
0030 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	11 05	0000	9.4		6	343		222	0.030	0.700	0.030	0.009
	11 05	0005	9.4	10.6		345		220	0.050	0.800	0.060	0.008
	11 05	0015	9.4	10.6		345		222	0.020	0.900	0.020	0.011
	11 05	0020	9.4	10.6		346		226	0.050	0.800	0.060	0.012
74/07/02	11 00	0000	23.5	6.0	36	472	7.90					
	11 00	0005	23.5	6.0		470	7.90					
	11 00	0015	23.5	6.0		470	7.80					
	11 00	0025	23.4	6.0		475	7.80					
74/09/26	13 30	0000	17.6	8.6	42	406	7.79	278	0.050	1.200	0.030	0.030
	13 30	0005	17.5	9.2		405	7.78	260	0.040	1.000	0.020	0.027
	13 30	0015	17.2	8.6		403	7.76	260	0.040	0.900	0.020	0.025

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00631 INCDT LT REMNING PERCENT
74/04/17	11 05	0000	0.028	11.0	
	11 05	0005	0.030		
	11 05	0015	0.030		
	11 05	0020	0.028		
74/07/02	11 00	0000		9.8	
	11 00	0005			1.0
74/09/26	13 30	0000	0.083	32.1	
	13 30	0004			1.0
	13 30	0005	0.082		
	13 30	0015	0.066		

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STORET RETRIEVAL DATE 75/12/23

310103
40 57 25.0 096 52 19.0
BRANCHED OAK
31109 NEBRASKA

11EPALES
3

2111202
0017 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	11	30 0000	9.2		54	344		226	0.040	0.900	0.050	0.005
	11	30 0005	9.2	10.2		344		226	0.040	0.800	0.040	0.005
	11	30 0012	9.1	10.4		343		224	0.030	0.800	0.030	0.009
74/07/02	11	20 0000	22.9	6.0	36	469	7.80					
	11	20 0005	22.8	5.8		469	7.80					
	11	20 0015	22.8	5.8		468	7.80					
	11	20 0020	22.7	6.2		469	7.80					
74/09/26	14	15 0000	17.2	8.4	42	406	7.73	290	0.040	0.800	0.020	0.023
	14	15 0005	17.1	8.4		404	7.73	242	0.040	0.700	0.020	0.023
	14	15 0010	17.1	8.8		404	7.74	272	0.040	0.700	0.020	0.023

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/17	11	30 0000	0.038	12.9	
	11	30 0005	0.031		
	11	30 0012	0.028		
74/07/02	11	20 0000		6.4	
	11	20 0006			1.0
74/09/26	14	15 0000	0.068	21.1	
	14	15 0005	0.079		
	14	15 0007			1.0
	14	15 0010	0.067		

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APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

3101A1
40 57 59.0 096 50 30.0
OAK CREEK
31029 7.5 RAYMOND
O/BRANCHED OAK LAKE
SEC RD BRDG .7 MI SE OF BR OAK LAKE DAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	09 15		0.820	0.400	0.050	0.310	0.340
74/09/21	10 45		0.830	0.300	0.040	0.280	0.300
74/10/19	10 45		0.736	0.400	0.050	0.360	0.420
74/11/15	17 00		0.880	0.300	0.065	0.330	0.350
74/12/07	13 20		0.830	0.500	0.085	0.300	0.440
75/01/12	09 30		1.400	1.900	0.144	0.320	0.600
75/02/02	10 30		1.720	1.100	0.212	0.180	0.240
75/03/11	12 20		0.062	1.200	0.058	0.031	0.070
75/04/12	13 20		0.070	0.950	0.075	0.015	0.070
75/05/04	09 30		0.030	0.950	0.035	0.020	0.040
75/06/07	13 35		0.075	1.000	0.105	0.055	0.090
75/07/12	14 40		0.105	1.100	0.100	0.070	0.100

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STORET RETRIEVAL DATE 76/01/27

3101A2
41 00 33.0 096 54 40.0
OAK CREEK
31 7.5 VLPRAISO SW
T/BRANCHED OAK LAKE
CO RD BRDG 8 MI NE OF GARLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/25	10 00		1.010	0.500	0.075	0.200	0.230
74/09/22	10 20		1.080	1.100	0.165	0.175	0.195
74/10/20	10 00		0.240	0.500	0.035	0.055	0.140
74/11/16	15 15		1.060	0.500	0.085	0.040	0.110
74/12/14	10 05		0.990	0.400	0.045	0.090	0.140
75/03/16	15 00		0.935	2.000	0.169	0.175	0.230
75/04/13	14 30		0.490	0.980	0.220	0.125	0.180
75/05/02	14 40		0.310	1.350	0.095	0.130	0.190
75/05/17	09 47		0.670	0.350	0.200	0.190	0.348
75/06/08	14 30		0.440	1.250	0.165	0.210	0.350
75/06/22	14 00		0.610	2.400	0.120	0.345	0.750

STORET RETRIEVAL DATE 76/01/27

3101A3
41 05 23.0 096 57 24.0
OAK CREEK
31 7.5 VLPHAISO SW
T/BRANCHED OAK LAKE
SEC RD BRDG 3.5 MI ENE OF DWIGHT
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/25	09 20		0.840	0.300	0.015	0.160	0.164
74/09/22	09 45		1.920	0.900	0.120	0.230	0.240
74/10/20	09 30		0.736	0.400	0.027	0.180	0.210
74/11/16	14 35		1.060	1.700	0.055	0.080	0.160
74/12/14	09 35		1.240	1.000	0.065	0.115	0.150
75/03/16	14 30		0.764	2.700	0.089	0.184	0.210
75/04/13	14 05		0.540	1.150	0.165	0.105	0.140
75/05/02	14 10		0.370	1.150	0.315	0.115	0.160
75/05/17	09 30		1.100	0.650	0.185	0.080	
75/06/08	14 05		0.750	1.250	0.065	0.145	0.260
75/06/22	13 37		0.510	1.730	0.220	0.220	0.370

STORET RETRIEVAL DATE 76/01/27

310181
40 58 48.0 096 55 45.0
MIDDLE OAK CREEK
31 7.5 GARLAND
T/BRANCHED OAK LAKE
CO RD BRDG 5.2 MI NE OF GARLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/25	10 15		1.720	0.600	0.045	0.115	0.160
74/09/22	10 40		1.920	0.900	0.045	0.155	0.230
74/10/20	10 10		0.672	0.600	0.030	0.125	0.140
74/11/16	15 30		1.440	0.700	0.075	0.105	0.130
74/12/14	10 15		1.360	0.700	0.125	0.095	0.140
75/03/16	15 15		0.957	1.900	0.273	0.184	0.300
75/04/13	14 45		0.525	1.050	0.330	0.085	0.190
75/05/02	14 50		0.480	1.500	0.395	0.123	0.180
75/05/17	10 00		0.810	0.650	0.105	0.160	0.222
75/06/08	14 40		0.430	0.930	0.085	0.160	0.210
75/06/22	14 14		0.760	2.200	0.150	0.270	0.500

STORET RETRIEVAL DATE 76/01/27

3101C1
41 01 00.0 096 54 32.0
UNNAMED CREEK
31 7.5 VLPRAISO SW
T/BRANCHED OAK
AT SEC RD BRDG 4.0 MI W OF AGNEW
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/25	09 50		0.570	1.300	0.120	0.150	0.290
74/09/22	10 10		0.416	1.500	0.115	0.100	0.260
74/10/20	09 55		0.248	1.200	0.055	0.125	0.320
74/11/16	15 00		0.504	1.500	0.345	0.140	0.230
74/12/14	10 00		3.000	1.000	0.200	0.025	0.160
75/02/22	14 15		3.050	2.400	0.464	0.040	0.260
75/03/16	14 45		3.135	2.950	0.524	0.267	0.385
75/04/13	14 25		0.710	2.600	0.075	0.040	0.220
75/05/02	14 30		0.760	1.800	0.490	0.110	0.190
75/05/17	09 40		0.500	0.275	0.165	0.105	0.205
75/06/08	14 20		0.300	1.500	0.145	0.115	0.200
75/06/22	13 54		0.380	1.750	0.220	0.130	0.260

STORET RETRIEVAL DATE 76/01/27

31011C
40 54 03.0 096 48 21.0
WEST OAK CREEK
31109 7.5 RAYMOND
T/BRANCHED OAK LAKE
SEC RD BRDG 3.1 MI E OF MALCOLM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	09 45		3.200	1.000	0.050	0.400	0.480
74/09/21	11 15		2.900	0.600	0.035	0.315	0.375
74/10/19	10 15		2.080	0.700	0.045	0.290	0.360
74/11/15	16 30		1.840	0.600	0.080	0.260	0.340
74/12/07	13 45		1.550	0.600	0.040	0.230	0.320
75/01/12	10 25		4.000	1.100	0.096	0.368	0.600
75/02/02	09 45		0.850	0.500	0.124	0.264	0.440
75/03/16	12 00		1.445	1.600	0.196	0.231	0.370
75/04/12	14 00		0.735	1.000	0.065	0.180	0.290
75/05/04	10 40		0.840	1.700	0.060	0.190	0.270
75/06/07	13 10		1.250	0.700	0.020	0.310	0.340
75/07/12	13 35		2.200	1.050	0.165	0.350	0.440

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